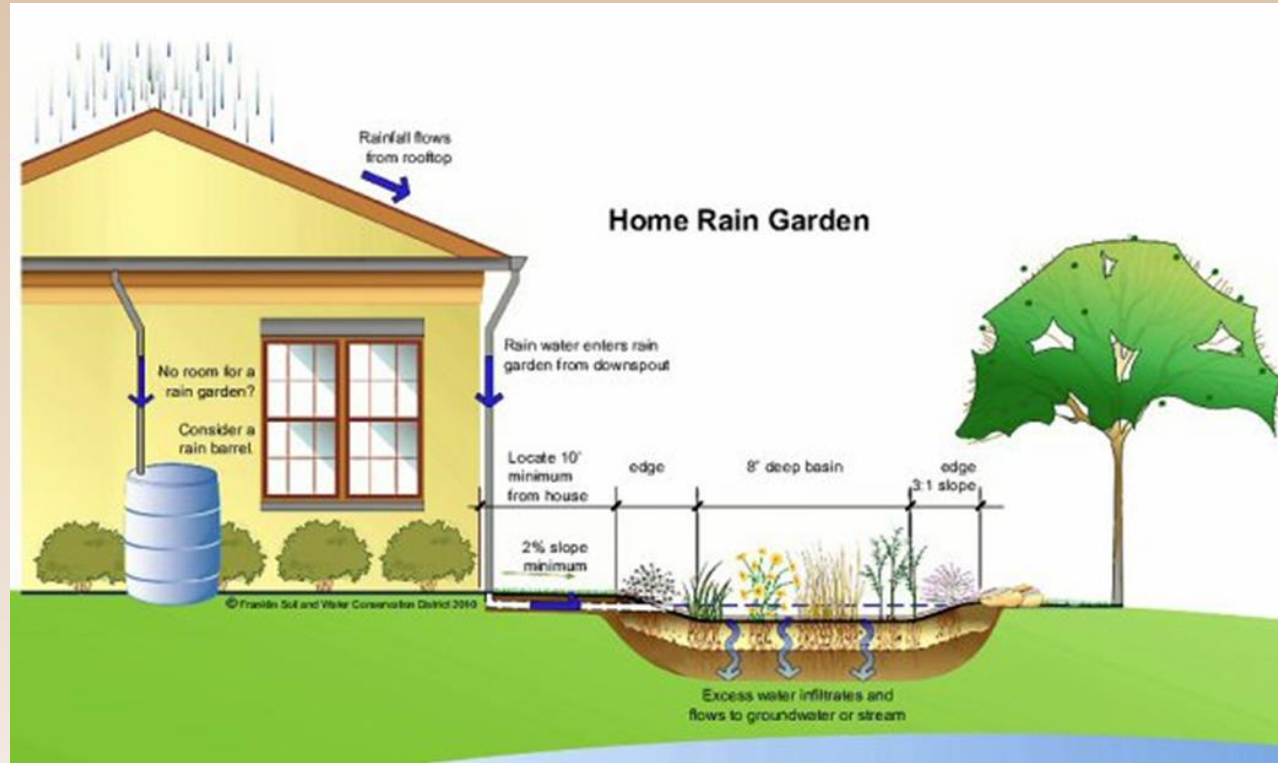


Rain garden Technical Standard

March 6, 2020 WI Land + Water Workshop

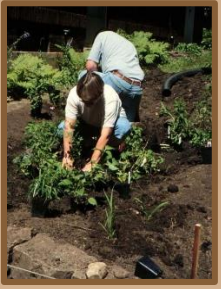


Presented By:

Perry Lindquist, Land Resources Manager, Waukesha County

Presentation Outline

- Why a raingarden technical standard?
- Review of WDNR Rain Garden Standard (& User Guide)
 - Technical standard WDNR 1009 (September 2018)
 - User guide/manual (WDNR PUB-WT-776 2018)
- Questions



Technical Standard 1009

User Guide/Manual

WISCONSIN DEPARTMENT OF NATURAL RESOURCES
TECHNICAL STANDARD
RAIN GARDEN
1009

DEFINITION

A rain garden is a storm water management practice consisting of a shallow depression planted with a dense cover of vegetation, designed to capture storm water runoff¹ from a small drainage area and infiltrate it into the underlying soil.

PURPOSE

A rain garden may be used individually or as part of a system of storm water management practices to support one or more of the following purposes:

- (1) Enhance storm water infiltration,
- (2) Reduce discharge of pollutants from storm water to surface water,
- (3) Increase groundwater recharge,
- (4) Decrease runoff peak flow rates and volumes,
- (5) Preserve lake levels and base flows in streams,
- (6) Reduce temperature impacts of storm water runoff,
- (7) Reduce downstream erosion or adverse drainage,
- (8) Promote mitigation of runoff closer to its origin, such as a roof downspout.

CONDITIONS WHERE PRACTICE APPLIES

Rain gardens apply to small drainage areas where storm water discharges are a concern, and the soil, site and runoff conditions are suitable for infiltration. Rain gardens are best suited for providing on-site storm water management in landscaped areas that receive runoff from small rooftops which are considered low pollutant risks.

Rain gardens are not suitable for controlling sediment from construction site erosion or treating large areas of impervious surfaces. Rain gardens also have limited applicability where there are clay soils, shallow bedrock, or high groundwater conditions.

This standard contains design limitations for the size of contributing drainage areas (watersheds) and excludes applicability to watersheds where significant sources of sediment or salt-based deicers are present or anticipated. If site conditions or applicable regulations present significant challenges, applying this standard may require the assistance of a professional or the use of other technical standards, such as those designated for storm water infiltration or bioretention.

¹ Words in the standard that are shown in *italics* are described in the Definitions section. The words are italicized the first time they are used in the text.

Technical Standards are reviewed periodically and updated if needed. To obtain the current version of this standard, contact your local WDNR office or the Standards Oversight Council office in Madison, WI at (608) 441-2677.

RAIN GARDENS

A GUIDE FOR HOMEOWNERS
AND LANDSCAPERS

WISCONSIN STANDARDS OVERSIGHT COUNCIL
WISCONSIN DEPARTMENT OF NATURAL RESOURCES

NOVEMBER 2018 | WWW.SOCWISCONSIN.ORG | WWW.DNR.WI.GOV

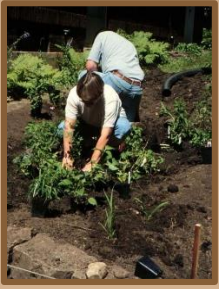
Why a Rain Garden Technical Standard?

■ Purposes

- Maximize success in installations (protect our natural resources)
- Limit failures & associated conflict/liabilities
- Ensure fairness/consistency in bidding, cost-sharing & regulations

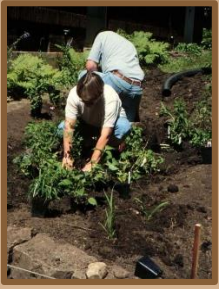
■ Some driving forces to develop a RG standard

- Shoreland zoning: Impervious surface limits (NR 115)
- Stormwater permits for small sites (NR 151)
- Municipal cost-sharing programs/MS4 credits (NR 216)
- Contractors (level playing field)



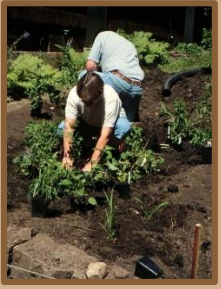
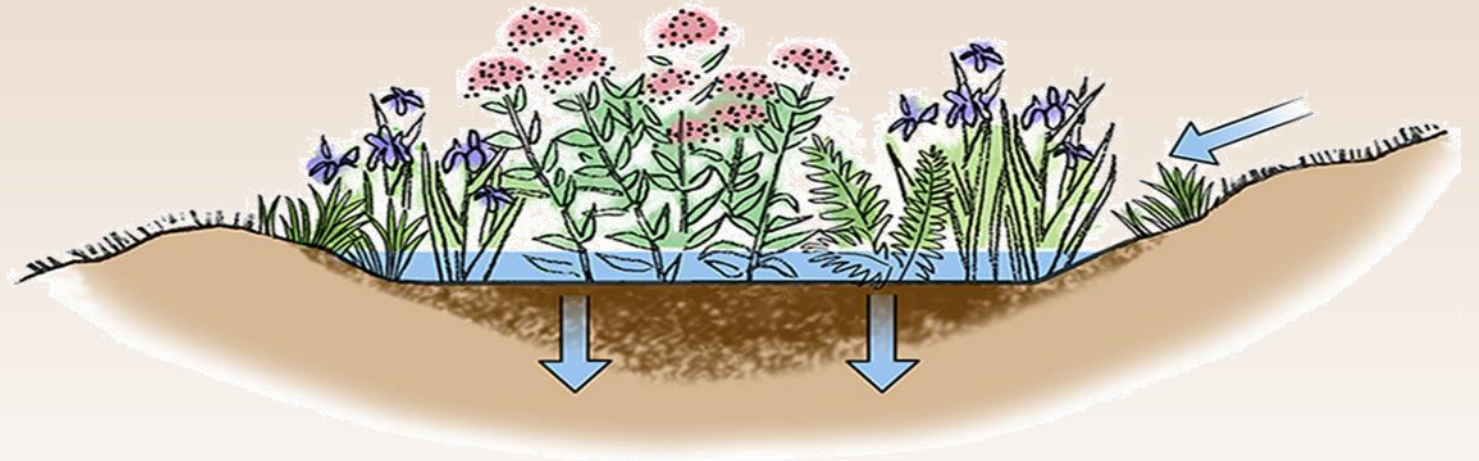
Standards Oversight Council Process

- 25 years coordinating federal & state BMP technical stds.
- SOC Guiding Principles:
 - Quality (Science-based standards)
 - Uniformity (Same standards among agencies/programs)
 - Openness & Accountability (Public comment period, etc.)



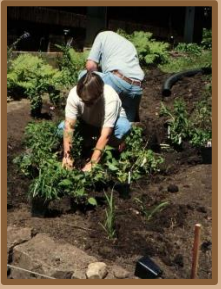
Definition (of rain garden)

- Shallow depression
- Planted with a dense cover of vegetation
- Captures storm water *runoff* from a small *drainage area*
- *Infiltrates* it into the underlying soil.



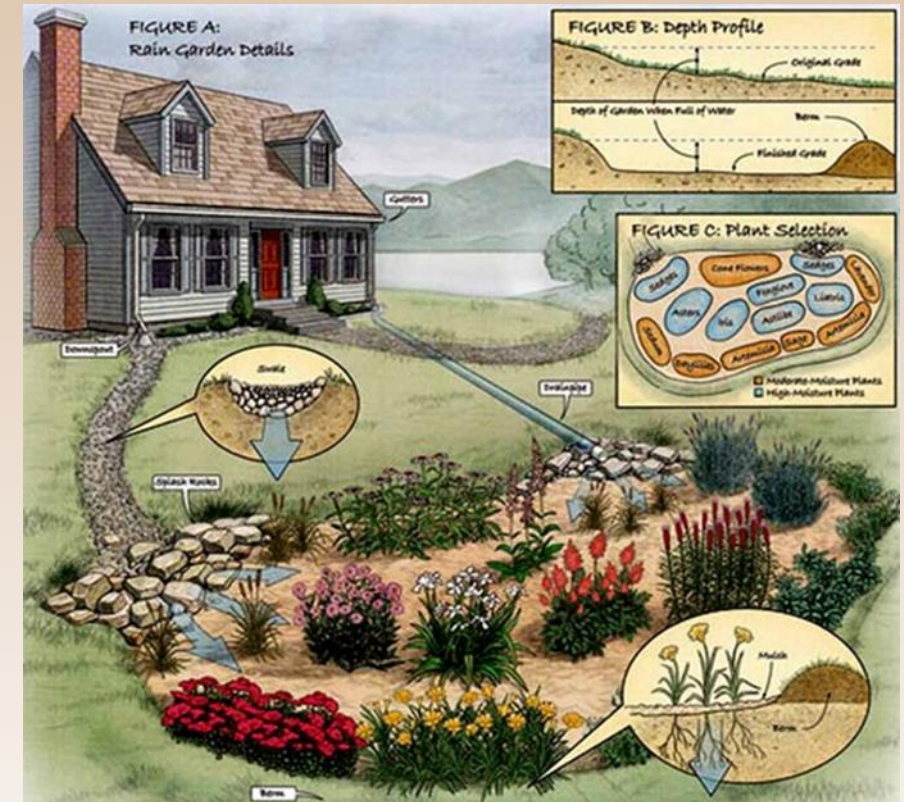
Purpose(s) of a rain garden

- Enhance infiltration
- Reduce runoff volumes, peak flows & pollution
- Groundwater recharge (maintain lake levels/stream flows)
- Reduce temperature impacts of runoff
- Reduce downstream erosion or *adverse drainage*
- Promote runoff mitigation close to its origin (downspout)



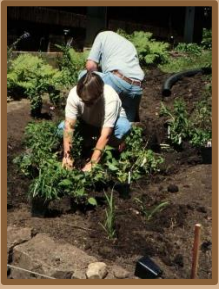
Conditions Where Practice Applies

- Best suited for:
 - Small rooftops/drainage areas
 - Soil and slope are suitable for infiltration
 - Landscaped areas (on-site)
 - Low pollutant risks (drainage area)



Conditions Where Practice Applies (cont.)

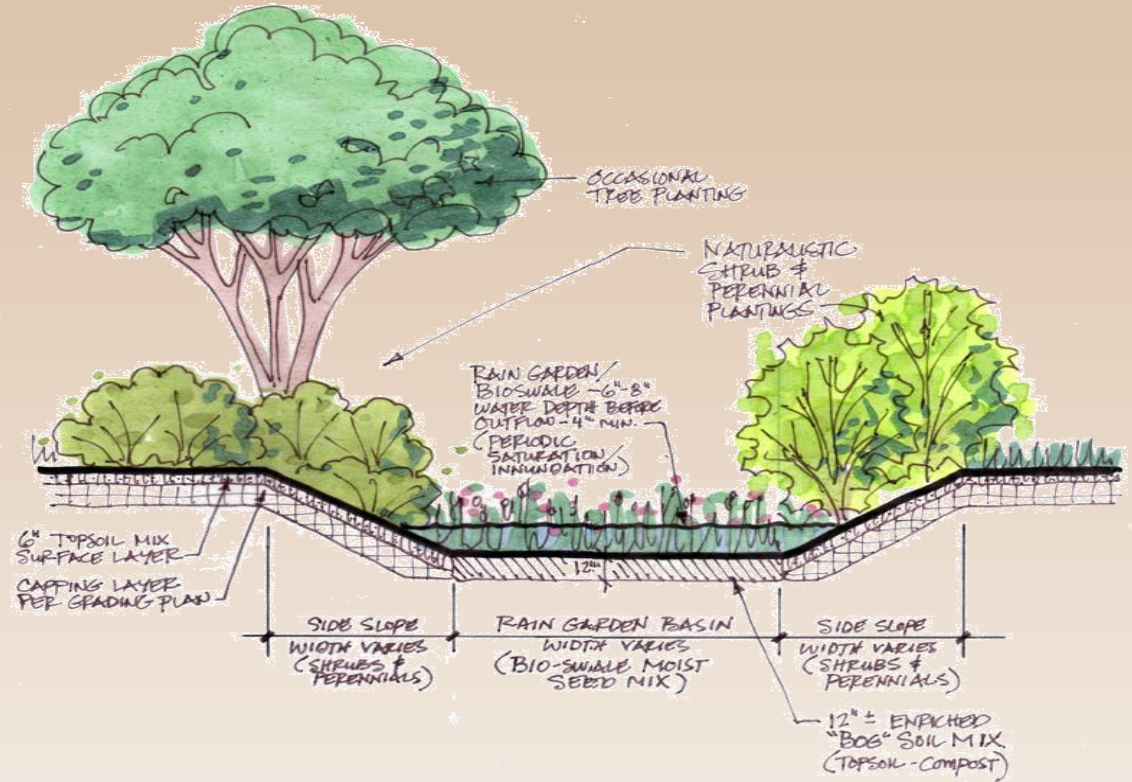
- NOT Suited where these are in drainage area:
 - Construction site erosion (sediment)
 - Large areas of impervious surfaces
 - Salt-based deicers
- Limited application where these are present:
 - Shallow *bedrock*
 - *High groundwater*
 - Clayey soils



Criteria

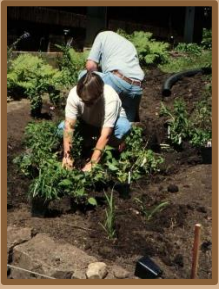
- Establishes minimums for:

- Site assessment
- Design
- Construction
- Planting
- Operation & maintenance



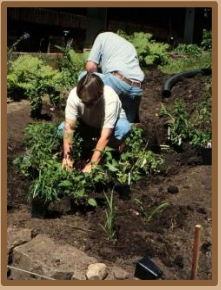
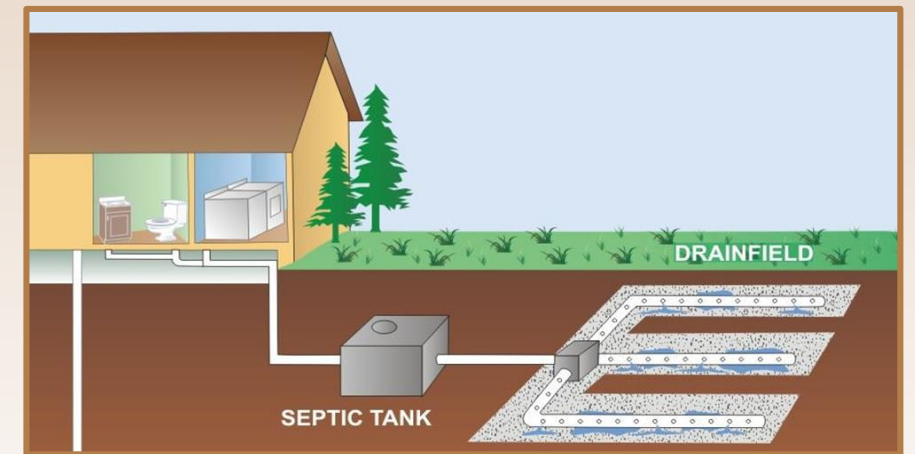
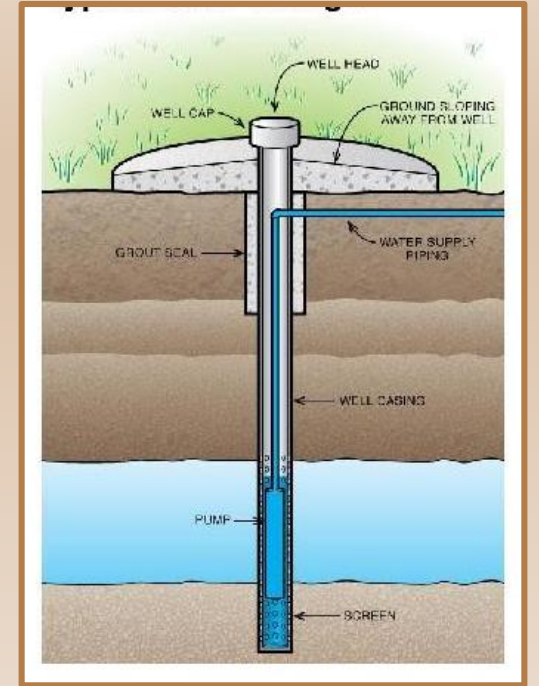
Site Criteria (site assessment required)

- Setbacks
- **Soil limitations**
- Slopes
- **Drainage area**
- Trees
- Erosion/adverse drainage
- Utilities
- Septic systems



Setbacks

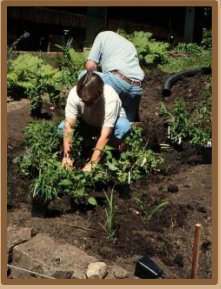
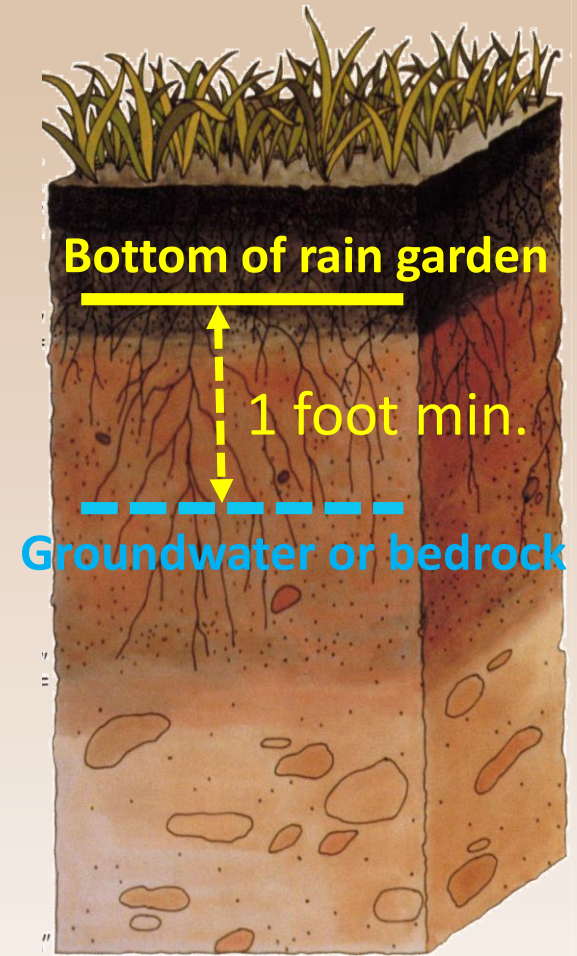
- Cannot be *hydraulically connected* to buildings, wells or septic systems
 - HC = Surface or subsurface flow conduit
- Minimum setback distances:
 - Basements: 10 feet
 - Frost footings: 5 feet
 - Wells: 8 feet
 - Get regulatory review if within 25 feet
 - Septic system: 5 feet



Soil limitations

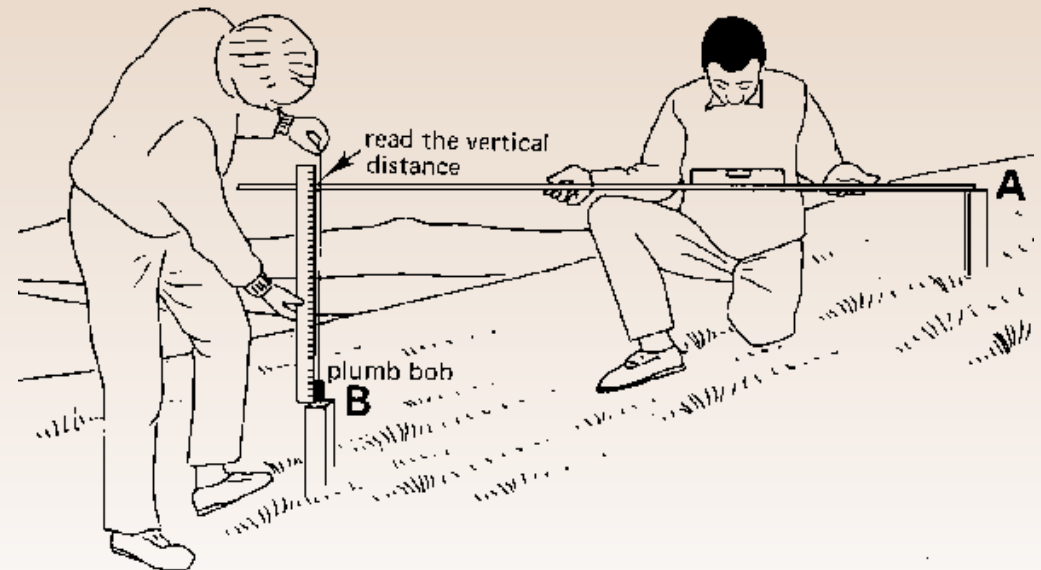
- 1 foot above *high groundwater**
- 1 foot above *bedrock**
 - If Soil Survey shows 1-3 feet to bedrock, consult professional
- Clayey soil:
 - *Clay loam** – use native plants; shallow depth
 - Any higher clay content – not suitable

* May need professional assistance to determine



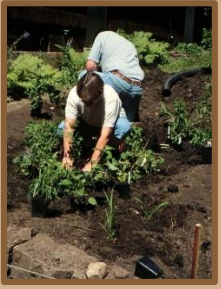
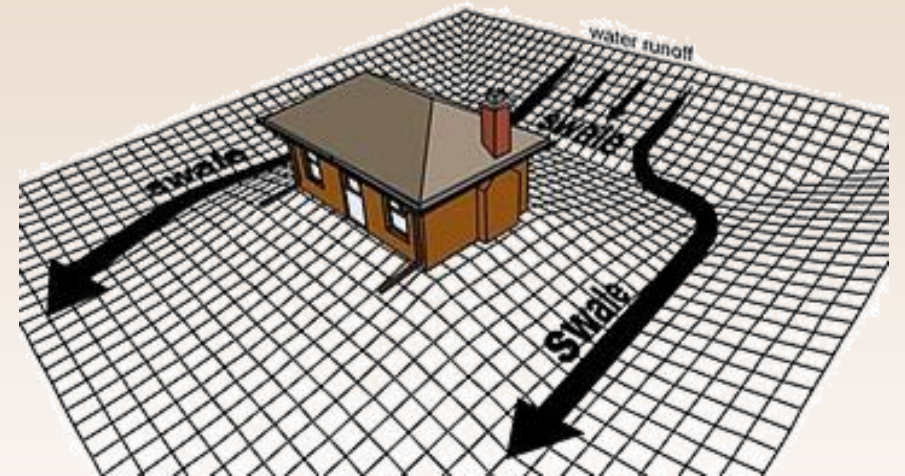
Slopes

- Locate on 8:1 (H:V) or flatter slopes
- Cut/fill slopes on perimeter 2:1 or flatter
 - Unless slope is supported by landscape stone/block/wall



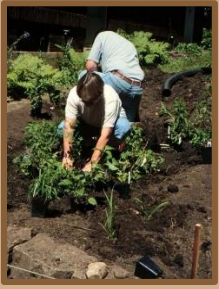
Drainage area (watershed)

- Maximum 3,000 sq. ft. impervious surface
 - Residential/small commercial
- Maximum 5,000 sq. ft. total drainage area (with lawn)
 - Could divert runoff or split flows to two rain gardens if over these

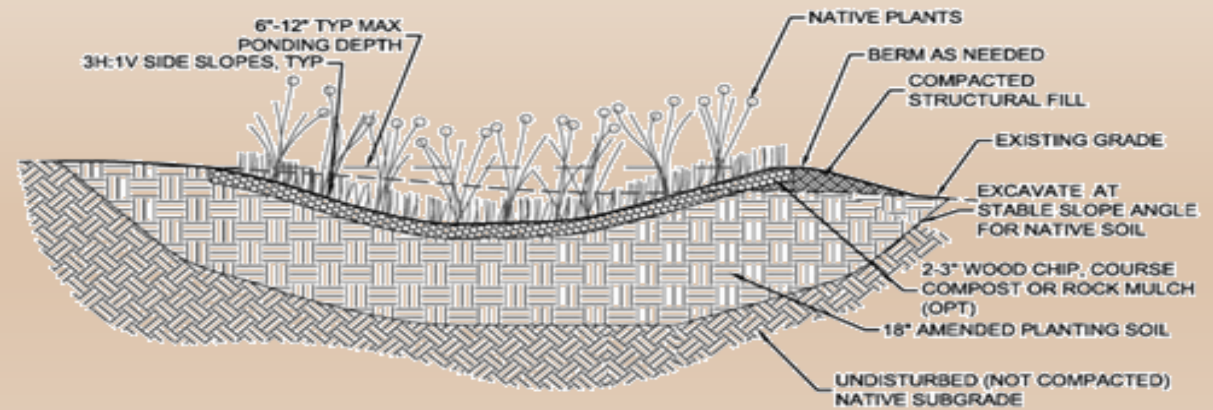


Site Assessment Example

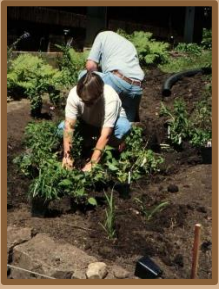
- NOT Suited where these are in drainage area:
 - Large areas of impervious surfaces
 - Salt-based deicers
- Limited application where these are present:
 - Clayey soils



Design Criteria



- Ponding area (sizing)
- Drainage area
- Ponding depth
- Soil type/infiltration rates
- Configuration
- Downslope edge
- Design overflow
- Planting bed
- Vegetation plan
- Soil treatment/erosion control
- Construction



Ponding area (sizing)

- Definition: Bottom of rain garden, not including side slopes
- Size: depends on three factors:
 - ponding depth
 - soil infiltration rate
 - target rainfall capture rate (% average annual runoff volume)
- See Table 2
 - Easy to use (Based on extensive modeling)
 - **Preferred drawdown period of <24 hours**

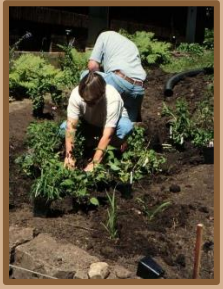
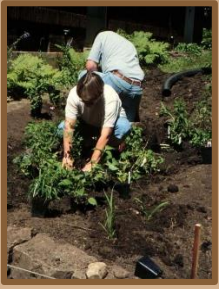


Table 2
**Rain Garden Sizing Factors for Various
Runoff Volume Control Goals, Soil Types and Ponding Depths**

Rain Garden Ponding Depth (inches)	Sizing Factor Based on Soil Type/Design Infiltration Rate and Runoff Volume Control Goal				
	Clay Loam (0.15 in/hr)	Silt Loam (0.30 in/hr)	Loam ^{Note 2} (0.50 in/hr)	Loamy Sand (1.0 in/hr)	Sand (2.0 in/hr)
Sizing Factors for Goal of 75 Percent Runoff Volume Control ^{Note 3}					
3-5	0.15	0.11	0.08	0.07	0.04
6-7	0.12 ^{Note 4}	0.09	0.07	0.05	0.03
8	0.10 ^{Note 4}	0.08	0.06	0.04	0.03
Sizing Factors for Goal of 90 Percent Runoff Volume Control ^{Note 5}					
3-5	0.23	0.19	0.15	0.12	0.07
6-7	0.18 ^{Note 4}	0.14	0.12	0.09	0.06
8	0.15 ^{Note 4}	0.12	0.10	0.07	0.05
Sizing Factors for Goal of 100 Percent Runoff Volume Control					
3-5	0.44	0.35	0.30	0.23	0.17
6-7	0.35 ^{Note 4}	0.30	0.23	0.18	0.13
8	0.25 ^{Note 4}	0.23	0.18	0.13	0.11

Soil Type/Infiltration Rate

- Two methods allowed to determine:
 - Conduct soil texture analysis (Attachment 2)
 - Conduct on-site soil infiltration test
- Soil texture analysis:
 - Collect sample 4-6 inches below surface
 - Assumes shallow rain garden depth
 - Could collect sample from underlying soil as well to make sure no limiting layer exists



Attachment 2 - Identifying Soil Texture

Collect a few teaspoons of soil from 4-6 inches beneath the surface. Place 2 teaspoons of soil in the palm of your hand and add drops of water until the consistency is smooth and moldable, like moist putty.

Squeeze the soil. Does the soil remain in a ball when squeezed?

YES

NO

Place the ball between your thumb and forefinger. Gently push the soil with your thumb to squeeze the soil upward, into a ribbon. Form a ribbon of uniform thickness and width. Allow the ribbon to emerge and extend over your forefinger until it breaks under its own weight. Does the soil form a ribbon?

Your soil is sandy. Use the **SAND** sizing criteria from Table 2.

NO

YES

How long is the ribbon before it breaks off?

Your soil is loamy sand. Use the **LOAMY SAND** sizing criteria from Table 2.

< 1 inch

1 – 2 inches

> 2 inches

Excessively moisten a small pinch of soil in your palm and rub with your forefinger. What is the grittiness of the soil?

Excessively moisten a small pinch of soil in your palm and rub with your forefinger. What is the grittiness of the soil?

Your soil is **CLAYEY** and the site should not be used for a main garden.

Gritty, like sugar.
Your soil is a sandy loam. Use the **LOAMY SAND** sizing criteria from Table 2.

Gritty, like sugar.
Your soil is a sandy clay loam. Use the **CLAY LOAM** sizing criteria from Table 2.

Smooth, like flour.
Your soil is a silt loam. Use the **SILT LOAM** sizing criteria from Table 2.

Smooth, like flour.
Your soil is a silty clay loam. Use the **CLAY LOAM** sizing criteria from Table 2.

Neither gritty nor smooth. Your soil is loamy. Use the **SILT LOAM** sizing criteria from Table 2.

Neither gritty nor smooth. Your soil is clay loam. Use the **CLAY LOAM** sizing criteria from Table 2.

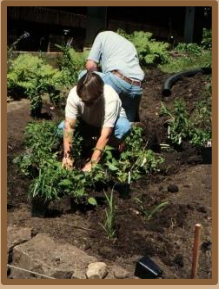
Ball test (yes or no?)



Ribbon test (length?)



Palm rub (Gritty or Smooth)?



Soil Infiltration rates

- Two methods of testing infiltration rate:
 - Double ring infiltrometer (professional); or
 - Attachment 1 (simplified method)
- Maximum infiltration rate: 2 inches/hour (both methods)



Double ring infiltrometer



Simplified method (home materials)

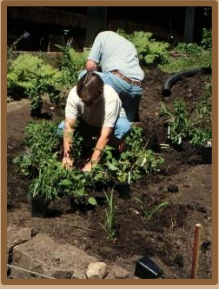


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Example Ponding Area Calculation (Table 2)

- 800 sf pervious
- 900 sf impervious
 - Silt loam soil
 - 90% runoff control
 - 6-7 inch RG depth

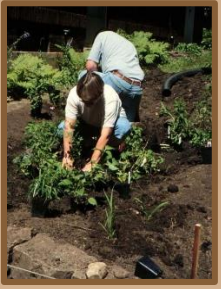
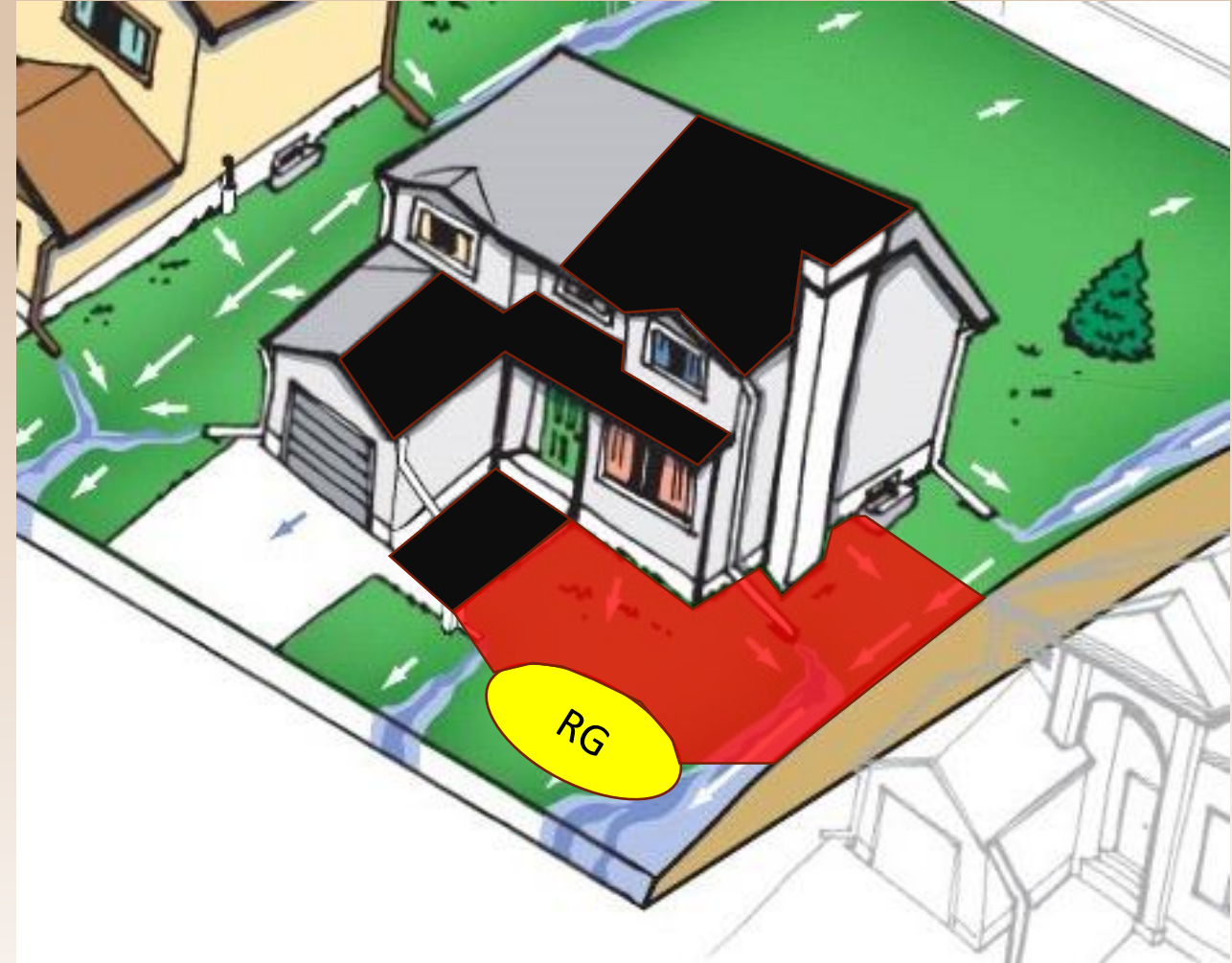


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Pervious

Example Ponding Area Calculation

- 800 sf pervious
- 900 sf impervious
 - Silt loam soil
 - 90% runoff control
 - 6-7 inch RG depth

$$800 \text{ sf} \times 0.09 = 72 \text{ sf (pervious)}$$

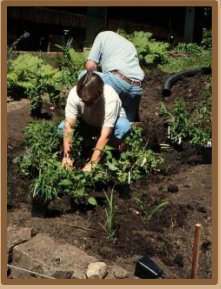
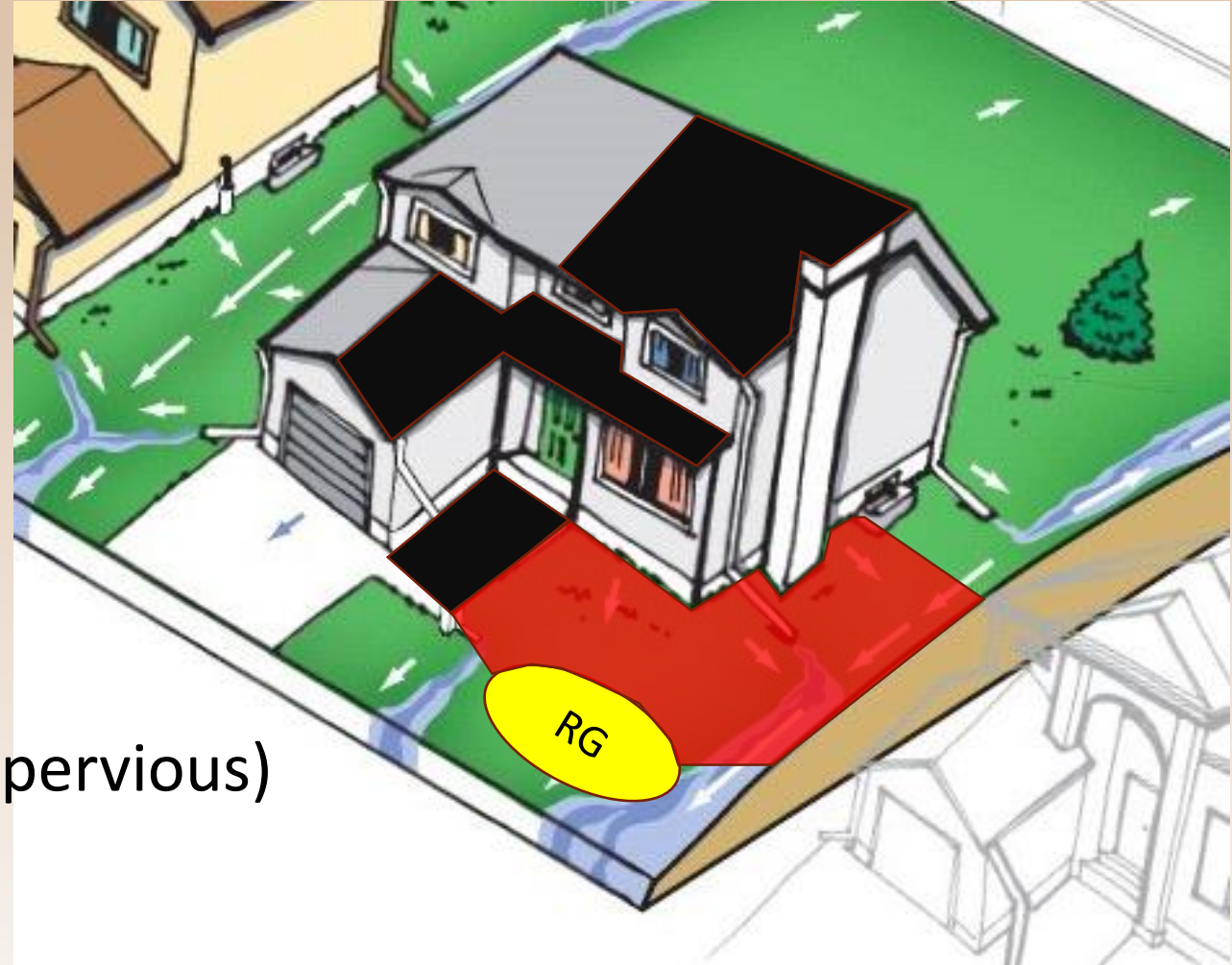


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Impervious

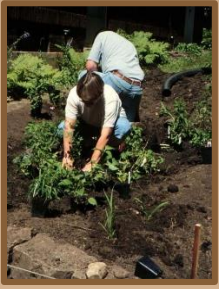
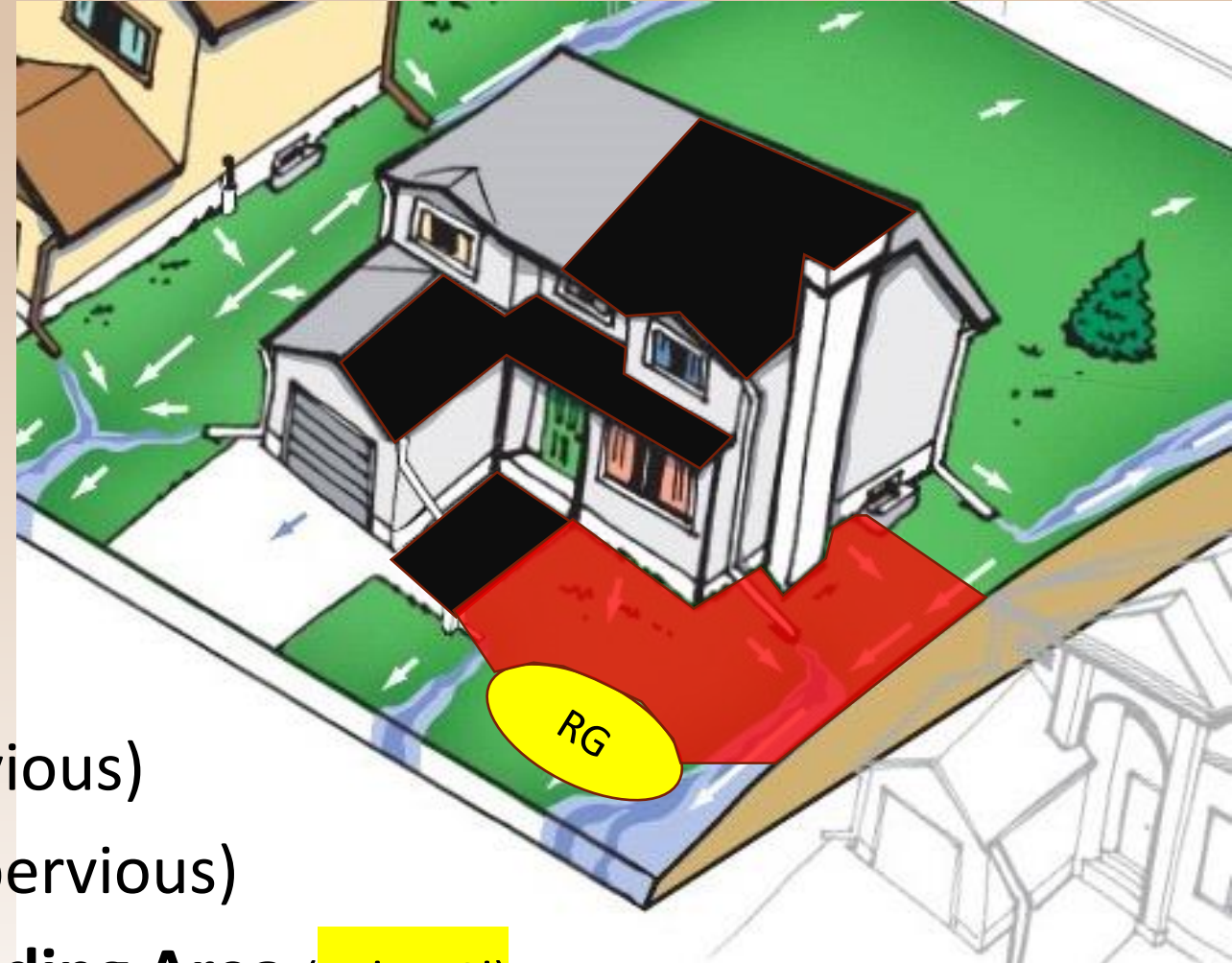
Example Pooling Area Calculation

- 800 sf pervious
- 900 sf impervious
 - Silt loam soil
 - 90% runoff control
 - 6-7 inch RG depth

$$800 \text{ sf} \times 0.09 = 72 \text{ sf (pervious)}$$

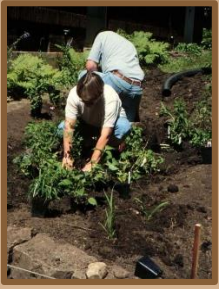
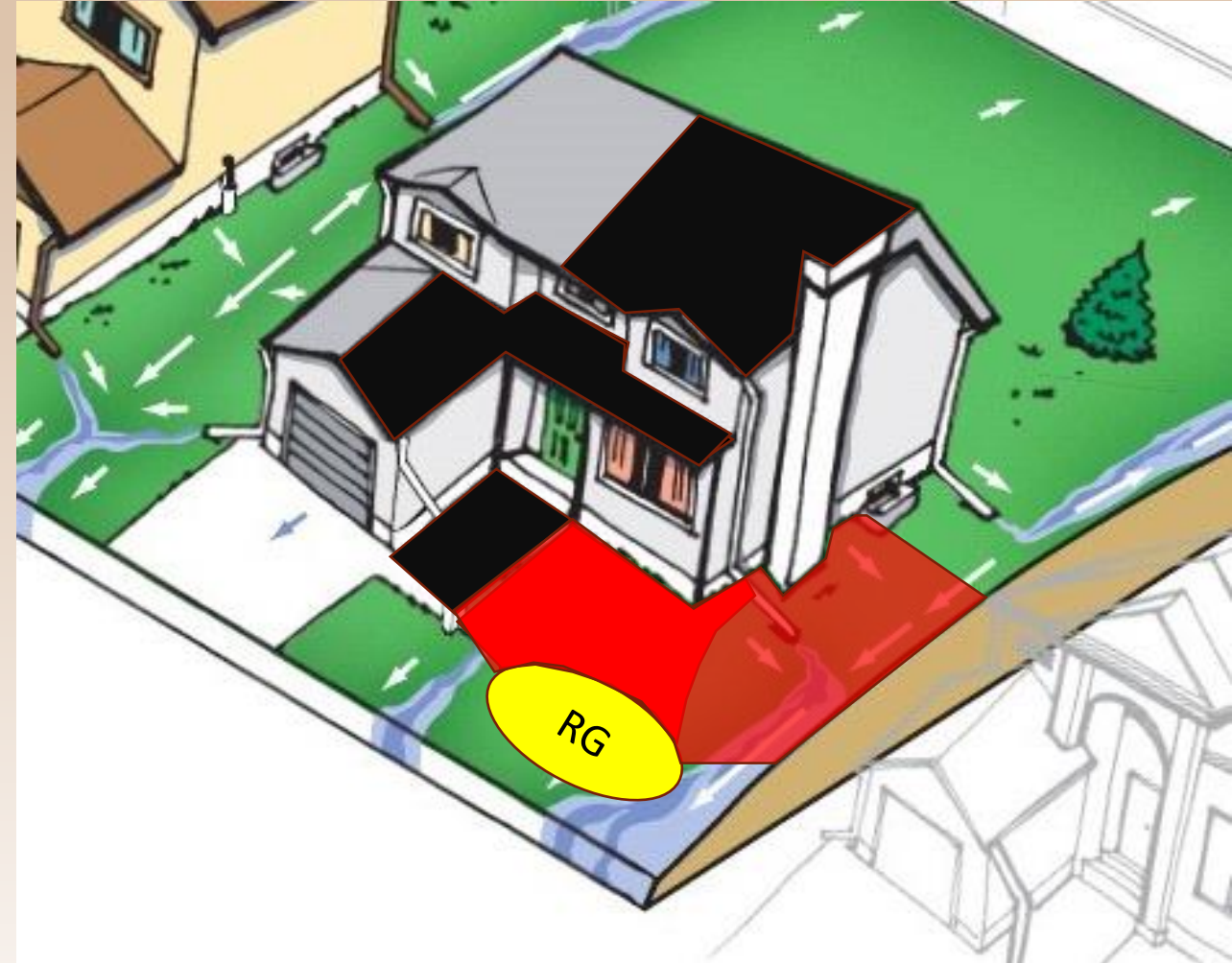
$$900 \text{ sf} \times 0.14 = \underline{126 \text{ sf (impervious)}}$$

198 sf Ponding Area (11' x 18')



Example Pooling Area Calculation (reduce watershed)

- 800 sf pervious
- 900 sf impervious
 - Silt loam soil
 - 90% runoff control
 - 6-7 inch RG depth



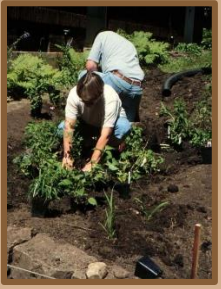
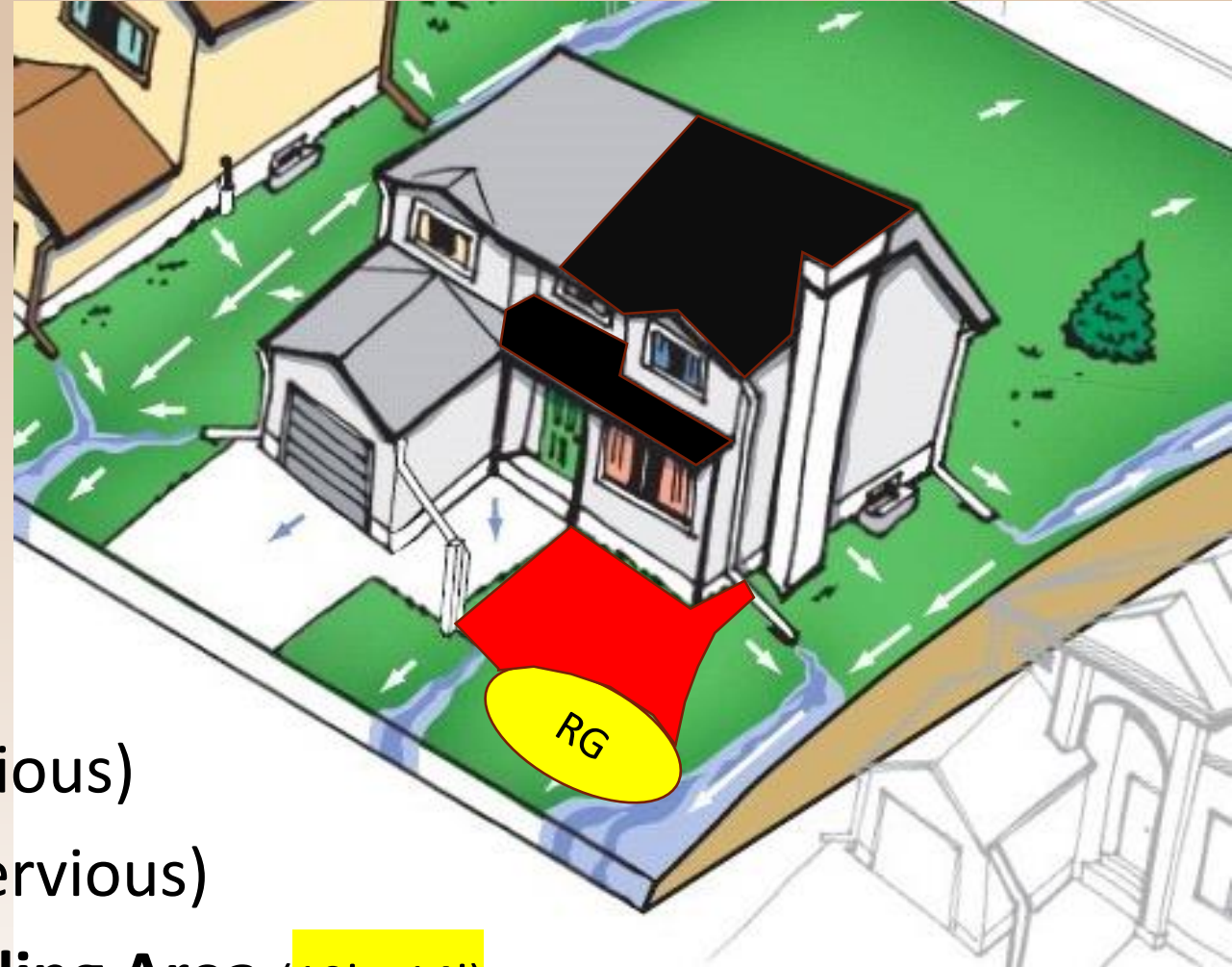
Example Ponding Area Calculation (reduce watershed)

- 500 sf pervious
- 650 sf impervious
 - Silt loam soil
 - 90% runoff control
 - 6-7 inch RG depth

$$500 \text{ sf} \times 0.09 = 45 \text{ sf (pervious)}$$

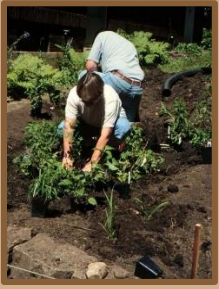
$$650 \text{ sf} \times 0.14 = \underline{91 \text{ sf (impervious)}}$$

136 sf Ponding Area (10' x 14')



Berms

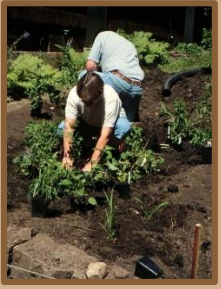
- Usually cut/fill balance on site
 - Fill only to meet 1' separation to bedrock or groundwater
 - Cut only = hauling soil
- Compaction required
- Top width: minimum 12 inches
- Side slopes: maximum 2:1 (H:V)
 - Unless supported (stone, block)



Downslope Edge

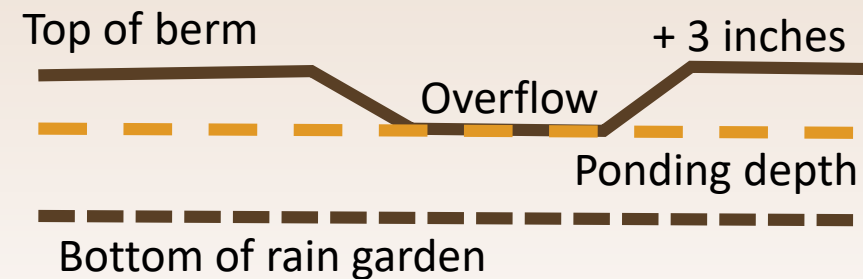


- Top of berm or controlling elevation of surrounding ground
- Must direct outflow to stable outlet
- Avoid creating “adverse drainage conditions”
 - Affecting other properties
 - If a certain discharge flow path is needed, use “design overflow”



Design Overflow

- Small level channel through the berm
 - Overflow for large rain events
 - Directs overflow
- Top of berm 3 inches above overflow
- Design width 1-3 feet (Table 3)
 - Depending on impervious drainage area



Planting Bed (bottom)

- Maximum 1% slope (flat)
- Over-excavate if subsoils are difficult for planting
 - Reapply topsoil
- Use compost to amend soil (optional)

FIGURE 1.1

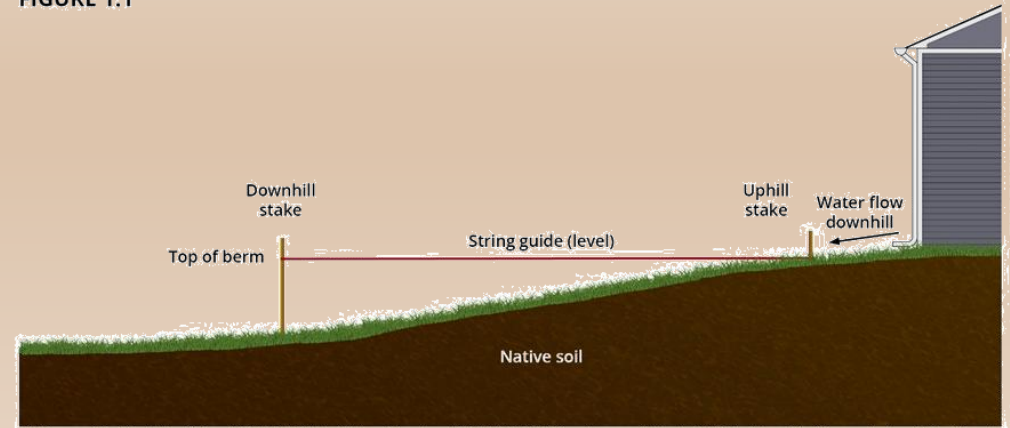


FIGURE 1.2



FIGURE 1.3

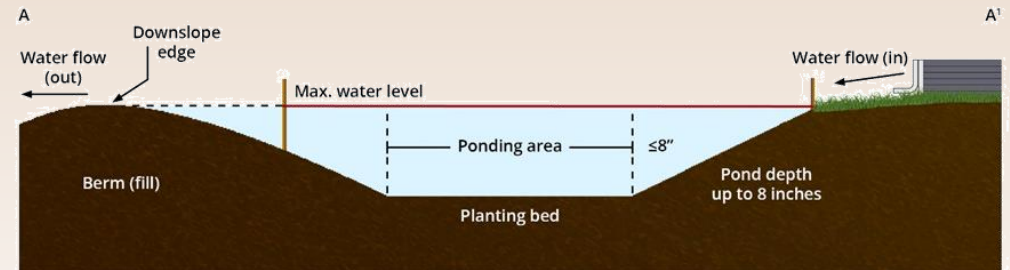
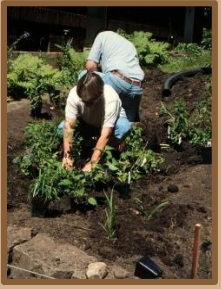


FIGURE 1 - THE PROCESS OF DIGGING A RAIN GARDEN

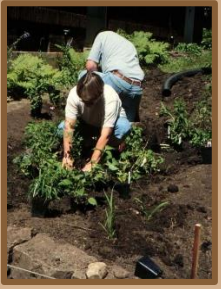
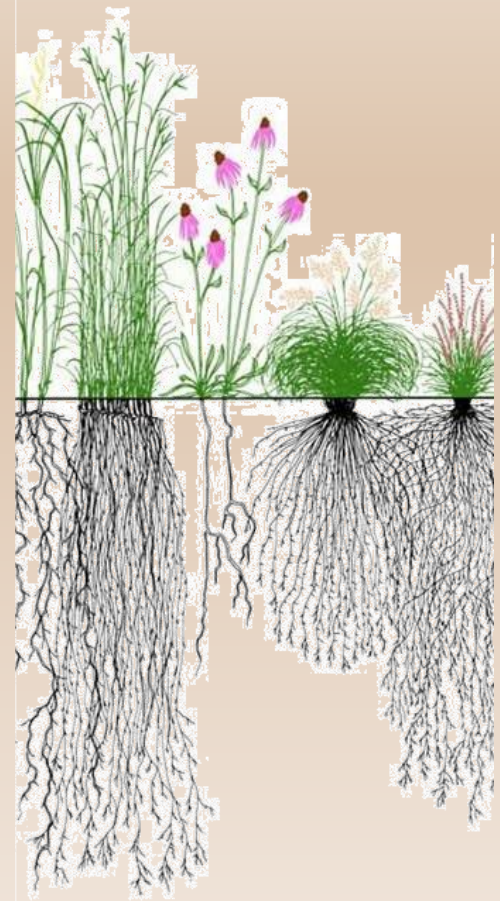
Not to Scale



Vegetation Plan



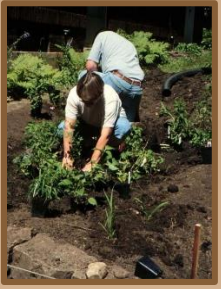
- May include: natives, perennials or turf grass
- Deep rooted native plants work best
 - Enhance infiltration
 - Withstand flooding & drought conditions
- Turf grass has limited ponding depth in clay loam soils (Table 2)



Planting Standards

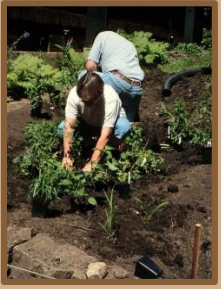


- Native planting:
 - Plant plugs – 1 plant/sq. ft., apply mulch first
 - Prairie sod – use anchors (2 foot grid)
 - Seed – most difficult, not recommended (must divert flows)
- Water and weeding is critical (control invasives)



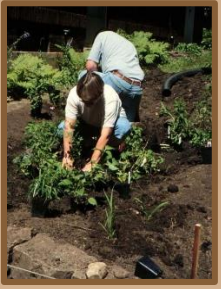
Soil Treatment

- Minimize erosion, suppress weeds, reduce compaction, and preserve moisture until plants are well established
- Three choices:
 - Shredded mulch 1-2 inches (before plant plugs)
 - Staked erosion matting (seeding)
 - Sod (turf or prairie)
- Matting on overflows



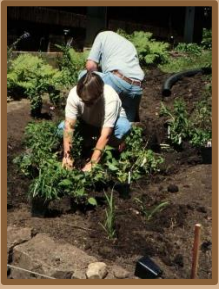
Clay Loam soils

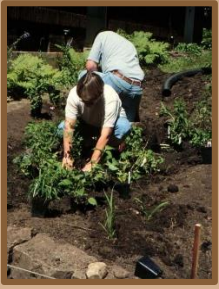
- Challenging – long drain down times
- Table 2: Only 3-5 inches deep is allowed
- Deep rooted natives recommended (water tolerant)
- Divert flows 1st year (if possible)
- Amend the soil with compost
- Add drain tile around bottom (need outlet)



Professionals assistance ?

- Outlet pipe designs
- Larger/deeper rain garden designs
- *Bedrock/groundwater* determinations
- Soil/infiltration interpretations
- Watershed delineation
- *Hydraulically connected* issues
- Drain tile installation (clay loam)



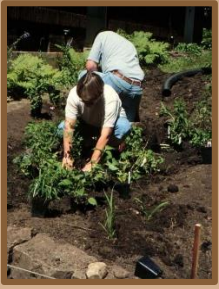


Operation & Maintenance

Activity	Frequency
Inspect rain garden	3 times per growing season
Water plants	As needed – after planting & drought period
Monitor water level after large rain	Especially during first year
Remove nuisance or invasive plants	As needed per inspections
Replant void areas	As needed per inspections
Treat diseased trees & shrubs	As needed per inspections
Repair erosion & berm settling	As needed per inspections
Remove trash & debris	As needed per inspections
Remove excessive dead plant material	Annually (spring recommended)

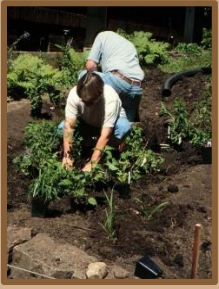
Summary of Key Issues

- Applicability: No salt, small watersheds (roofs)
- Watersheds:
 - Maximum 3,000 sq. ft. impervious surface (per cell)
 - Maximum 5,000 sq. ft. total (per cell)
- Sizing: based on soil type, ponding depth and % runoff control
 - Table 2 - 75%, **90%**, 100% (average annual runoff)
- Infiltration rate: Soil texture or infiltration test required
- Vegetation: Encourage native planting, allows turf/perennials
- Maintenance: 3x per year inspection (2-3 yr. establish period)



Thanks to the Rain Garden Team!

- **Perry Lindquist**, Waukesha County, Team Leader
- **Roger Bannerman**, former WDNR/USGS
- **Jim Baumann**, former WDNR
- **Frank Hassler**, Good Oak Ecological Services
- **Leif Hauge**, Senior Civil Engineer, Waukesha County
- **Judy Horwathich**, USGS
- **Eric Jacobson**, Aspen Garden and Landscape
- **Ken Potter**, former University of Wisconsin
- **Kate Brunner/Jennifer Thieme**, SOC Program Manager



Questions?



<https://dnr.wi.gov/topic/Stormwater/raingarden/>

https://dnr.wi.gov/topic/stormwater/standards/postconst_standards.html

